

Report for 2001HI2082B: Confirming the Natural Presence of Fecal Indicator Bacteria in Environmental Soil and Water on the Islands of Kauai and Hawaii

- Other Publications:

- Vithanage, G, 2002, Assessment of sewage pollution in Hawaii's stream based on concentrations of FRNA coliphages, poster presented at 24th annual Hawaii Water Environment Association conference, Hawaii Convention Center, Honolulu, Hawaii.
- Vithanage, G.; G. Ueunten; E. Akazawa; R. Fujioka, 2003, Need for alternative fecal indicators (*C. perfringens*, coliphages) to assess hygienic quality of streams and beaches on Kauai, Hawaii, abstract of poster presented at 103rd general meeting of the American Society for Microbiology, Washington, D.C., p. 590.
- Fujioka, R.; K. Luther; G. Vithanage, 2004, Assessment of FRNA coliphages in tropical streams: Sewered versus non-sewered area, invited talk presented at the International Workshop on Coliphages as Indicators of Fecal Contamination in Water and Other Environmental Media, Crowne Plaza Hotel, Arlington, Virginia, sponsored by United States Environmental Protection Agency, Office of Water.

Report Follows

Problem and Research Objectives

Based on studies conducted on the island of Oahu over many years, we have determined that the U.S. Environmental Protection Agency (EPA) recreational water quality standards are not applicable in the state of Hawaii. The reason is that the two assumptions used by EPA in interpreting the public health significance of exceeding water quality standards do not apply to the state of Hawaii. The first assumption is that there are no significant environmental sources of fecal indicator bacteria other than feces and sewage. We have determined that soil in Hawaii is a natural habitat for fecal indicator bacteria. The second assumption is that the fecal indicator bacteria cannot multiply under natural environmental conditions. We have determined that environmental conditions (temperature, moisture, nutrients) in Hawaii's soil environment enable these fecal indicator bacteria to multiply.

All streams on Oahu consistently contain excessively high concentrations of fecal indicator bacteria (fecal coliform, *Escherichia coli*, enterococci) and exceed EPA recreational water quality standards. The monitoring data from Hawaii based on EPA-approved fecal indicator bacteria cannot be used to determine when streams are actually contaminated with sewage. We have also determined that other fecal indicators (*Clostridium perfringens*, FRNA coliphages) can be used to determine when streams are contaminated with sewage. Although we have obtained sufficient monitoring data for Oahu, we have not obtained collaborative monitoring data for the neighbor islands. The primary objective of this study was to determine whether similar monitoring data would be obtained from stream water samples taken from the islands of Kauai and Hawaii when the methods used on Oahu are applied.

Methodology

EPA-approved methods were used to assay stream water samples obtained from Kauai for fecal coliform, *E. coli*, and enterococci. These same water samples were also assayed for *C. perfringens* and FRNA coliphages using methods published by EPA and established in our laboratory. Arrangements were made to have water samples sent to us from Kauai on a monthly basis. In addition, we traveled to Kauai on three occasions to obtain water samples. The Hanalei watershed and the Nawiliwili watershed were the study sites.

Principal Findings and Significance

We analyzed stream water samples from various sites on Kauai but primarily from the Hanalei watershed and from the Nawiliwili watershed. The results of the monitoring data showed that the EPA-approved fecal indicator bacteria (fecal coliform, *E. coli*, enterococci) are naturally present in high concentrations that exceed EPA recreational water quality standards. These results are similar to the results obtained for Oahu and indicate that the conclusions made from monitoring data on Oahu are applicable to Kauai and most likely to other islands throughout the state of Hawaii. Analysis of the same stream and coastal water samples from Kauai was also made for *C. perfringens* and FRNA coliphages, two indicators of sewage contamination in streams in Hawaii. The results showed high concentrations of *C. perfringens* and FRNA coliphages, similar to the results obtained for Oahu. These results confirm that monitoring environmental waters for *C. perfringens* is the most reliable test to determine when environmental waters are contaminated or are not contaminated with sewage throughout the state of Hawaii. Our studies have also shown much higher concentrations of FRNA coliphages in environmental water samples from Kauai than from Oahu. All sources of FRNA coliphages have not been determined, but these coliphages are always present in human sewage. The most likely sources of FRNA coliphages on Kauai are cesspools and septic tanks. This conclusion is based on two supporting observations. The first is that there are many more cesspools and septic tanks on Kauai than on Oahu. The second is that rain is much more prevalent on Kauai than on Oahu. More studies are needed to better characterize the sources of FRNA coliphages on Kauai.

The Hawaii island portion of this study, which was to begin in March 2002, was not funded.